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# Axial Pressure Drop Measurements during Pilot-Scale Testing of a Mott Crossflow Filter

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## SUMMARY

The Department of Energy selected caustic side solvent extraction (CSSX) as the preferred cesium removal technology for Savannah River Site waste. As a pretreatment step for the CSSX flowsheet, personnel contact the incoming salt solution that contains entrained sludge with monosodium titanate (MST) to adsorb strontium and select actinides. They filter the resulting slurry to remove the sludge and MST. We conducted pilot-scale crossflow filter testing with simulated SRS high level waste to evaluate the impact of operating parameters on the crossflow filtration process. During the tests, we measured the axial pressure drop as a function of axial velocity, feed slurry [i.e., sludge plus MST (5.6 M sodium), sludge plus MST (6.4 M sodium), sludge only, and sludge plus manganese dioxide], and insoluble solids concentration.

The conclusions from this work follow.

- The axial pressure drop varies with velocity$^{1.75}$, which agrees with theory.
- The axial pressure drop depends on the feed slurry, but the effect is less than observed for axial velocity. Sludge plus manganese oxide slurries produce the highest axial pressure drop and sludge plus MST slurries produce the lowest axial pressure drop.
- The effect of insoluble solids concentration is statistically insignificant. However, if the insoluble solids loading increased over the levels in these tests and the slurry became non-Newtonian, concentration may have a significant effect on axial pressure drop.
- The measured axial pressure drops are approximately 2X the value predicted based on pipe flow models. This observation agrees with similar data provided by a crossflow filter manufacturer.

## INTRODUCTION

The Department of Energy selected CSSX as the preferred cesium removal technology for Savannah River Site waste. As a pretreatment step for the CSSX flowsheet, personnel contact the incoming salt solution that contains entrained sludge with MST to adsorb strontium and select actinides. They filter the resulting slurry to remove the sludge and MST. The filtrate receives further treatment in the solvent extraction system. The baseline filtration technology uses a Mott crossflow filter.

We conducted pilot-scale crossflow filter testing with simulated SRS high level waste to evaluate the impact of operating parameters on the crossflow filtration process.[1,2,3,4] The feed slurries for these tests included simulated sludge plus MST, simulated sludge only, and simulated sludge plus manganese oxide solids. The supernate for these tests consisted of 5.6 – 6.4 M sodium, average salt solution. During the tests, we measured the axial pressure drop as a function of axial velocity, feed slurry, and insoluble solids concentration. This report documents the axial pressure drop data.

## TESTING

The testing occurred at the Filtration Research Engineering Demonstration (FRED) facility at the University of South Carolina shown in Figure 1. The FRED facility contains a filter element

with seven Mott filter tubes. Each tube is made from sintered stainless steel, 0.75 inches OD, 0.625 inches ID, 10 feet long, and nominal 0.5 micron pore size.


**Figure 1. Filtration Research Engineering Demonstration**

The simulated waste slurry contained nominally "average" Savannah River Site salt solution (5.6 – 6.4 M sodium). Table 1 shows the feed slurries along with the insoluble solids loadings.

Personnel set the tank temperature to 35 ± 3 °C, and added feed solids to reach the target concentration. They circulated the feed solution through the system to mix it.

Details of the filter test protocol are described in the individual test reports.[1-4] In some tests, personnel backpulsed the filter at the beginning of each test. The duration of the tests varied. These differences would affect the relationship between filter operating parameters and filter flux, but should have minimal impact on the relationship between filter axial velocity and axial pressure drop.

**Table 1. Feed Slurries and Insoluble Solids Loadings**

| Feed Slurry | Na (M) | Insoluble Solids (wt %) |
|---|---|---|
| Purex Sludge + MST | 6.4 | 0.05 |
| Purex Sludge + MST | 6.4 | 0.74 |
| Purex Sludge + MST | 6.4 | 0.05 |
| Purex Sludge + MST | 6.4 | 0.10 |
| Purex Sludge + MST | 6.4 | 0.20 |
| Purex Sludge + MST | 6.4 | 0.39 |
| Tank 40H/8F Sludge + MST | 5.6 | 0.033 |
| Tank 40H/8F Sludge + MST | 5.6 | 0.25 |
| Tank 40H/8F Sludge + MST | 5.6 | 1.1 |
| Tank 40H/8F Sludge + MST | 5.6 | 4.2 |
| Tank 8F Sludge | 5.6 | 0.044 |
| Tank 8F Sludge | 5.6 | 0.21 |
| Tank 8F Sludge | 5.6 | 0.88 |
| Tank 8F Sludge | 5.6 | 4.8 |
| Tank 40H Sludge + Manganese Oxide | 5.6 | 0.09 |
| Tank 40H Sludge + Manganese Oxide | 5.6 | 0.34 |
| Tank 40H Sludge + Manganese Oxide | 5.6 | 1.5 |
| Tank 40H Sludge + Manganese Oxide | 5.6 | 3.0 |

## RESULTS

Figure 2 shows the axial pressure drop as a function of axial velocity in the tests with 6.4 M sodium supernate, Purex sludge, and MST. (Attachment 1 contains the raw data.)

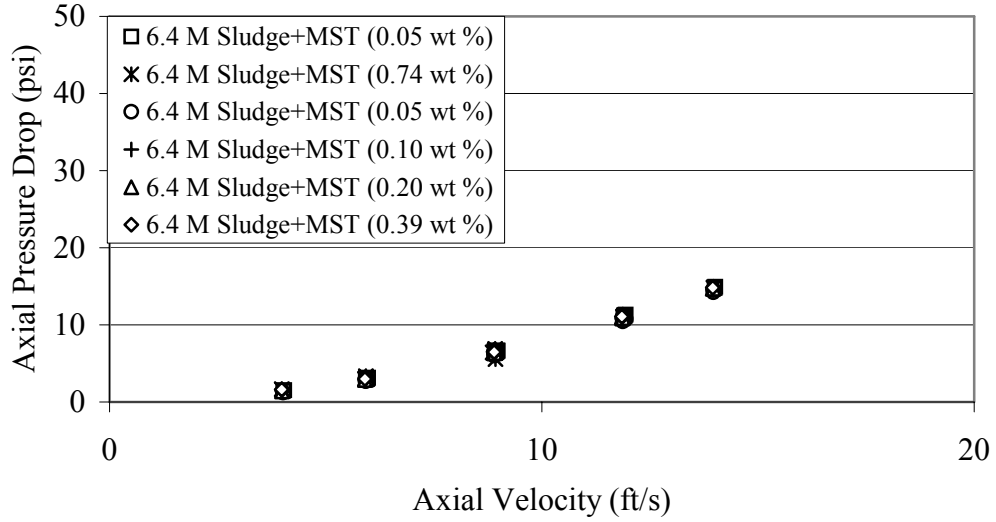


**Figure 2. Axial Pressure Drop during Test with 6.4 M Sodium Supernate, Purex Sludge, and MST**

Figure 3 shows the axial pressure drop as a function of axial velocity in the tests with 5.6 M sodium supernate, Tank 40H sludge, Tank 8F sludge and MST.

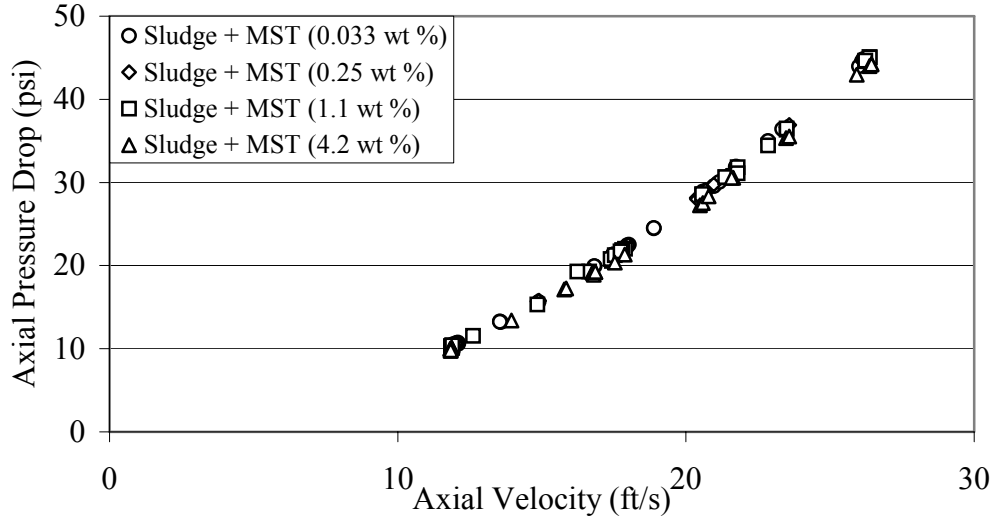


**Figure 3. Axial Pressure Drop during Test with 5.6 M Sodium Supernate, Tank 40H Sludge, Tank 8F Sludge, and MST**

Figure 4 shows the axial pressure drop as a function of axial velocity in the tests with 5.6 M sodium supernate and Tank 8F sludge.

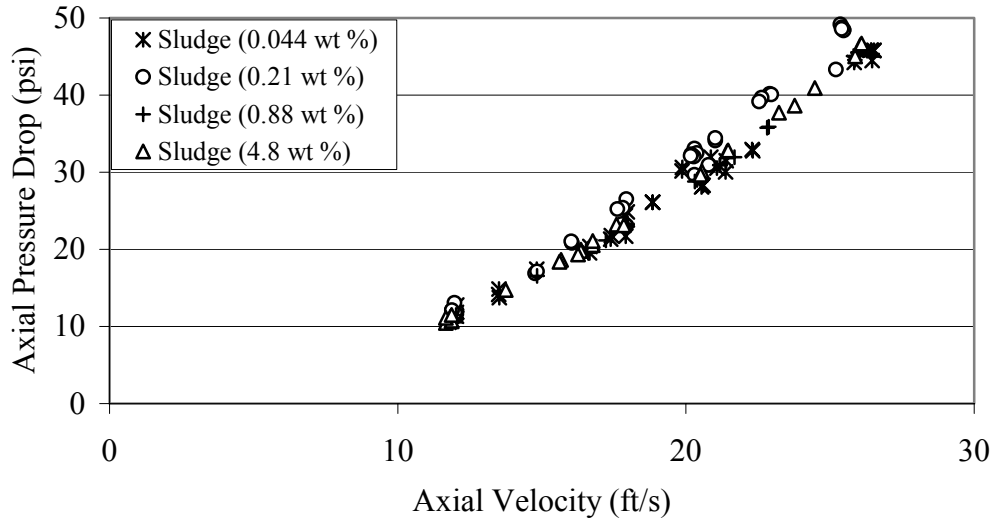


**Figure 4. Axial Pressure Drop during Test with 5.6 M Sodium Supernate and Tank 8F Sludge**

Figure 5 shows the axial pressure drop as a function of axial velocity in the tests with 5.6 M sodium supernate, Tank 40H sludge, and manganese dioxide solids.

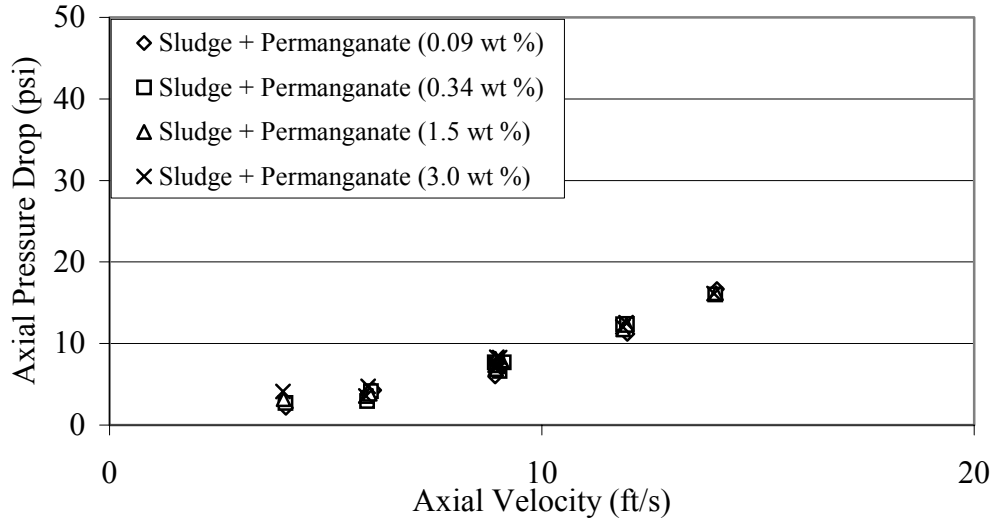


**Figure 5. Axial Pressure Drop during Test with 5.6 M Sodium Supernate and Tank 40H Sludge, and Manganese Oxide Solids**

Figure 6 shows the data from the four tests plotted together along with a theoretical prediction. One may calculate the axial velocity for turbulent pipe flow with equation [1]

$$-\Delta P = \frac{0.158 v^{1.75} \rho^{0.75} L \mu^{0.25}}{D^{1.25}} \qquad \text{for Re} > 10{,}000 \qquad [1]$$

where v is axial velocity, ρ is fluid density, L is tube length, μ is viscosity, D is tube diameter, and Re is the Reynolds number.[5] With the pilot-scale filter unit (D=0.625 in) and the SRS supernate (ρ=1.26 g/mL and μ =2.42 cp), an axial velocity of 4 ft/s produces a Reynolds number of 10,000. Since the minimum axial velocity tested equaled 4 ft/s, equation [1] applies.

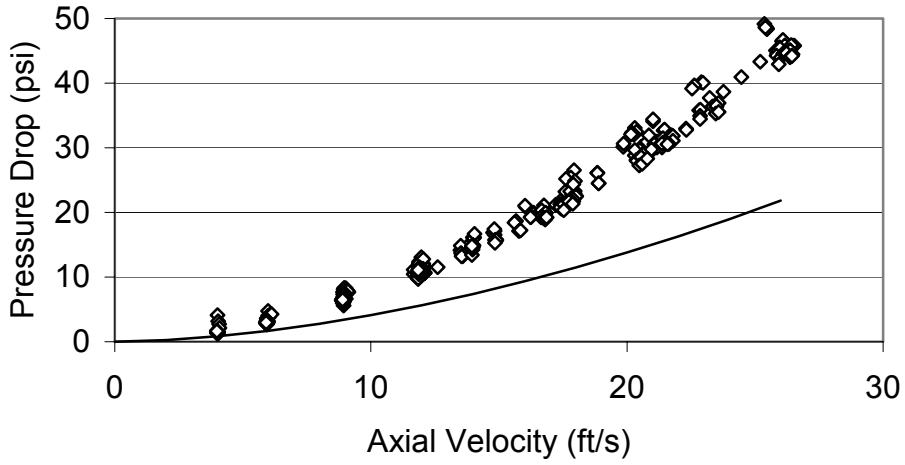


**Figure 6. Axial Pressure Drop**

The pressure drops measured with the pilot-scale filter are approximately 2X the value predicted by equation [1]. This observation agrees with data in the User's Manual for SCT Membranes produced by Membralox®, a manufacturer of crossflow filters.[6]

We conducted a statistical analysis of the data collected using the JMP® statistical software to determine which operating parameters influence the axial pressure drop. We regressed the data with a model described by equations [2] and [3]

$$-\Delta P = f(\text{feed})\ C\ v^{1.75} \qquad [2]$$

$$\ln[-\Delta P] = a_1 \ln[f(\text{feed})] + a_2 \ln[C] + a_3 \ln(v^{1.75}) \qquad [3]$$

where f is a function describing the effect of the variation in feed solution, C is the insoluble solids concentration, and $a_1$, $a_2$, and $a_3$ are constants. Table 2 shows the results of the statistical analysis.

**Table 2. Statistical Analysis of Axial Pressure Drop Data**

| Source | # parameters | Degrees freedom | Sum Squares | F-ratio | Prob.>F |
|---|---|---|---|---|---|
| Feed | 3 | 3 | 1.56 | 102 | < 0.0001 |
| Ln[C] | 1 | 1 | 0.00052 | 0.10 | 0.75 |
| Ln[$v^{1.75}$] | 1 | 1 | 127 | 25,000 | 0.0000 |

The F-ratio is the ratio of the mean square from the model to the mean square from the error. From the F-ratio, one can calculate the probability that the variation observed is due to error rather than to the parameter being investigated. If the probability is less than 0.05, the variation is due to the parameter and the effect of the parameter is statistically significant. The effect of feed slurry and axial velocity are statistically significant, with the axial velocity having the strongest effect.

Concentration does not have a significant effect on pressure drop over the range investigated. If one increased the insoluble solids concentration, and the slurry became non-Newtonian (i.e., Bingham Plastic), the concentration effect would likely become significant and the axial pressure drop would increase with increasing concentration.

Table 3 shows the estimates of the coefficients in equation [3]. The purpose of estimating the coefficients is not to develop an empirical correlation describing the axial pressure drop in the FRED facility, but rather to determine which feed slurries produce the largest axial pressure drop and to verify that the exponents describing the concentration and axial velocity effects are good approximations. The results show $v^{1.75}$ describes the effect of axial velocity on axial pressure drop well and that the effect of concentration on axial pressure drop is very small. The data also show that sludge plus manganese oxide slurries will produce the largest pressure drop followed by sludge only slurries, sludge plus MST (@ 6.4 M sodium) slurries, and sludge plus MST (@ 5.6 M sodium) slurries.

**Table 3. Coefficients for Axial Pressure Drop Model**

| Term | Estimate |
|---|---|
| Intercept | -2.0 |
| Feed(6.4 M Sludge + MST) | -0.056 |
| Feed (Sludge + MST) | -0.077 |
| Feed (Sludge + MnO2) | 0.13 |
| Ln[C} | 0.00073 |
| Ln[$v^{1.75}$] | 1.026 |

## CONCLUSIONS

The conclusions from this work follow.

- The axial pressure drop varies with velocity to the 1.75 power, which agrees with theory.
- The axial pressure drop depends on the feed slurry, but the effect is less than observed for axial velocity. Sludge plus manganese oxide slurries produce the highest axial pressure drop and sludge plus MST slurries produce the lowest axial pressure drop.
- The effect of insoluble solids concentration is statistically insignificant. However, if the insoluble solids loading increased over the levels in these tests and the slurry became non-Newtonian, concentration may have a significant effect on axial pressure drop.
- The measured axial pressure drops are approximately 2X the value predicted based on pipe flow models. This observation agrees with similar data provided by a crossflow filter manufacturer.

## REFERENCES

1. Ralph Haggard, Travis Deal, Carol Stork, and Vince Van Brunt, “Final Report on the Crossflow Filter Testing for the Salt Disposition Alternative”, USC-FRED-PSP-RPT-09-0-010, Rev. 0, December 4, 1998.
2. M. R. Poirier, “FY2000 FRED Test Report,”WSRC-TR-2001-00035, Rev. 0, January 11, 2001 and included report “Final Report on the Crossflow Filter Optimization with 5.6 M Sodium Salt Solution” (V. Van Brunt, C. Stork, T. Deal, and R. Haggard, USC-FRED-PSP-RPT-09-0-015, December 20, 2000).
3. V. Van Brunt, R. Haggard, T. Deal, C. Stork, M. R. Poirier, and S. D. Fink, “Cross-Flow Filtration of Simulated High-Level Waste Sludge (Tank 8F)”, WSRC-TR-2001-00195, April 20, 2001.
4. M. R. Poirier, S. D. Fink, R. Haggard, V. Van Brunt, R. Haggard, T. Deal, and C. Stork, “Comparison of Crossflow Filtration Performance for Manganese Oxide/Sludge Mixtures and Monosodium Titanate/Sludge Mixtures”, WSRC-TR-2002-00194, Rev. 0, April 19, 2002.
5. C. O. Bennett and J. E. Myers, Momentum, Heat, and Mass Transfer, 3rd Ed., McGraw-Hiil New York, 1982, p.168,198.
6. User’s Manual, SCT Membranes, Membralox®, March 1987.

# Attachment 1
# Crossflow Filter Axial Pressure Drop Data

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 66 | manganese oxide | 35 | 3.04 | 8.93 | 6.94 |
| 65 | manganese oxide | 35 | 3.04 | 5.93 | 3.59 |
| 64 | manganese oxide | 35 | 3.04 | 13.98 | 16.13 |
| 63 | manganese oxide | 35 | 3.04 | 9.02 | 8.29 |
| 62 | manganese oxide | 35 | 3.04 | 5.98 | 4.76 |
| 61 | manganese oxide | 35 | 3.04 | 8.94 | 7.28 |
| 60 | manganese oxide | 35 | 3.04 | 11.87 | 12.05 |
| 59 | manganese oxide | 35 | 3.04 | 8.96 | 8.33 |
| 58 | manganese oxide | 35 | 3.04 | 4.01 | 4.11 |
| 57 | manganese oxide | 35 | 3.04 | 11.95 | 12.56 |
| 56 | manganese oxide | 35 | 3.04 | 8.96 | 7.45 |
| 55 | manganese oxide | 35 | 1.52 | 9.01 | 7.23 |
| 54 | manganese oxide | 35 | 1.52 | 5.94 | 3.56 |
| 53 | manganese oxide | 35 | 1.52 | 14.03 | 16.16 |
| 52 | manganese oxide | 35 | 1.52 | 9.07 | 7.91 |
| 51 | manganese oxide | 35 | 1.52 | 6.02 | 3.83 |
| 50 | manganese oxide | 35 | 1.52 | 8.94 | 6.86 |
| 49 | manganese oxide | 35 | 1.52 | 11.88 | 11.74 |
| 48 | manganese oxide | 35 | 1.52 | 8.93 | 8.11 |
| 47 | manganese oxide | 35 | 1.52 | 4.03 | 3.16 |
| 46 | manganese oxide | 35 | 1.52 | 11.96 | 12.29 |
| 45 | manganese oxide | 35 | 1.52 | 8.92 | 7.35 |
| 44 | manganese oxide | 35 | 0.34 | 9.02 | 6.64 |
| 43 | manganese oxide | 35 | 0.34 | 5.96 | 2.96 |
| 42 | manganese oxide | 35 | 0.34 | 14.01 | 16.00 |
| 41 | manganese oxide | 35 | 0.34 | 9.12 | 7.68 |
| 40 | manganese oxide | 35 | 0.34 | 6.05 | 4.16 |
| 39 | manganese oxide | 35 | 0.34 | 8.96 | 7.49 |
| 38 | manganese oxide | 35 | 0.34 | 11.88 | 12.36 |
| 37 | manganese oxide | 35 | 0.34 | 8.91 | 7.68 |
| 36 | manganese oxide | 35 | 0.34 | 4.07 | 2.71 |
| 35 | manganese oxide | 35 | 0.34 | 11.97 | 12.42 |
| 34 | manganese oxide | 35 | 0.34 | 8.97 | 7.43 |
| 33 | manganese oxide | 35 | 0.07 | 9.07 | 7.94 |
| 32 | manganese oxide | 35 | 0.07 | 5.99 | 4.02 |
| 31 | manganese oxide | 35 | 0.07 | 14.05 | 16.69 |
| 30 | manganese oxide | 35 | 0.07 | 9.10 | 7.84 |
| 29 | manganese oxide | 35 | 0.07 | 6.12 | 4.27 |
| 28 | manganese oxide | 35 | 0.07 | 9.00 | 7.41 |
| 27 | manganese oxide | 35 | 0.07 | 11.91 | 12.09 |
| 26 | manganese oxide | 35 | 0.07 | 8.93 | 7.33 |
| 25 | manganese oxide | 35 | 0.07 | 4.08 | 2.12 |
| 24 | manganese oxide | 35 | 0.07 | 11.98 | 11.20 |
| 23 | manganese oxide | 35 | 0.07 | 8.92 | 5.98 |
| 22 | water | 50 | 0 | 9.88 | 4.28 |
| 21 | water | 50 | 0 | 6.72 | 1.11 |
| 20 | water | 50 | 0 | 14.95 | 10.64 |
| 19 | water | 50 | 0 | 10.15 | 4.50 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 18 | water | 50 | 0 | 7.11 | 2.22 |
| 17 | water | 50 | 0 | 9.85 | 4.97 |
| 16 | water | 50 | 0 | 12.61 | 8.55 |
| 15 | water | 50 | 0 | 9.54 | 5.27 |
| 14 | water | 50 | 0 | 5.00 | 1.99 |
| 13 | water | 50 | 0 | 12.95 | 9.83 |
| 12 | water | 50 | 0 | 9.80 | 6.11 |
| 11 | water | 30 | 0 | 9.79 | 6.44 |
| 10 | water | 30 | 0 | 6.66 | 3.37 |
| 9 | water | 30 | 0 | 14.88 | 13.28 |
| 8 | water | 30 | 0 | 10.03 | 6.55 |
| 7 | water | 30 | 0 | 7.04 | 3.43 |
| 6 | water | 30 | 0 | 9.80 | 5.95 |
| 5 | water | 30 | 0 | 12.66 | 9.31 |
| 4 | water | 30 | 0 | 9.54 | 5.35 |
| 3 | water | 30 | 0 | 5.04 | 1.41 |
| 2 | water | 30 | 0 | 13.01 | 9.74 |
| 1 | water | 30 | 0 | 10.87 | 6.17 |
| | | | | | |
| 150 | sludge only | 35 | 4.8 | 15.67 | 18.65 |
| 149 | sludge only | 35 | 4.8 | 15.61 | 18.40 |
| 148 | sludge only | 35 | 4.8 | 16.36 | 19.94 |
| 147 | sludge only | 35 | 4.8 | 24.47 | 40.92 |
| 146 | sludge only | 35 | 4.8 | 16.36 | 19.80 |
| 145 | sludge only | 35 | 4.8 | 11.83 | 11.25 |
| 144 | sludge only | 35 | 4.8 | 11.81 | 10.90 |
| 143 | sludge only | 35 | 4.8 | 11.67 | 10.46 |
| 142 | sludge only | 35 | 4.8 | 11.87 | 10.68 |
| 141 | sludge only | 35 | 4.8 | 11.87 | 10.76 |
| 140 | sludge only | 35 | 4.8 | 16.25 | 19.32 |
| 139 | sludge only | 35 | 4.8 | 13.75 | 14.71 |
| 138 | sludge only | 35 | 4.8 | 11.67 | 11.12 |
| 137 | sludge only | 35 | 4.8 | 17.59 | 23.21 |
| 136 | sludge only | 35 | 4.8 | 26.05 | 46.49 |
| 135 | sludge only | 35 | 4.8 | 21.43 | 32.68 |
| 134 | sludge only | 35 | 4.8 | 16.76 | 20.55 |
| 133 | sludge only | 35 | 4.8 | 11.87 | 11.48 |
| 132 | sludge only | 35 | 4.8 | 16.76 | 21.09 |
| 131 | sludge only | 35 | 4.8 | 21.46 | 32.84 |
| 130 | sludge only | 35 | 4.8 | 26.09 | 46.66 |
| 129 | sludge only | 35 | 4.8 | 23.23 | 37.73 |
| 128 | sludge only | 35 | 4.8 | 20.55 | 30.14 |
| 127 | sludge only | 35 | 4.8 | 17.84 | 23.12 |
| 126 | sludge only | 35 | 4.8 | 20.51 | 29.65 |
| 125 | sludge only | 35 | 4.8 | 23.77 | 38.65 |
| 124 | sludge only | 35 | 4.8 | 25.87 | 45.04 |
| 122 | sludge only | 35 | 0.88 | 17.95 | 23.32 |
| 121 | sludge only | 35 | 0.88 | 17.96 | 22.93 |
| 120 | sludge only | 35 | 0.88 | 17.94 | 23.17 |
| 118 | sludge only | 35 | 0.88 | 12.03 | 11.03 |
| 117 | sludge only | 35 | 0.88 | 12.00 | 10.54 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 116 | sludge only | 35 | 0.88 | 21.68 | 31.95 |
| 115 | sludge only | 35 | 0.88 | 17.90 | 22.59 |
| 114 | sludge only | 35 | 0.88 | 12.03 | 11.04 |
| 113 | sludge only | 35 | 0.88 | 12.00 | 10.78 |
| 112 | sludge only | 35 | 0.88 | 17.22 | 21.17 |
| 111 | sludge only | 35 | 0.88 | 11.99 | 10.95 |
| 110 | sludge only | 35 | 0.88 | 25.81 | 45.06 |
| 109 | sludge only | 35 | 0.88 | 16.61 | 20.12 |
| 108 | sludge only | 35 | 0.88 | 12.02 | 11.50 |
| 107 | sludge only | 35 | 0.88 | 14.83 | 16.54 |
| 106 | sludge only | 35 | 0.88 | 16.53 | 19.78 |
| 104 | sludge only | 35 | 0.88 | 25.97 | 45.55 |
| 103 | sludge only | 35 | 0.88 | 26.16 | 45.82 |
| 102 | sludge only | 35 | 0.88 | 25.86 | 44.57 |
| 101 | sludge only | 35 | 0.88 | 21.18 | 30.96 |
| 100 | sludge only | 35 | 0.88 | 16.61 | 19.62 |
| 99 | sludge only | 35 | 0.88 | 11.87 | 10.46 |
| 98 | sludge only | 35 | 0.88 | 16.61 | 19.54 |
| 97 | sludge only | 35 | 0.88 | 21.17 | 30.93 |
| 96 | sludge only | 35 | 0.88 | 25.89 | 45.07 |
| 95 | sludge only | 35 | 0.88 | 22.82 | 35.77 |
| 94 | sludge only | 35 | 0.88 | 20.39 | 29.02 |
| 93 | sludge only | 35 | 0.88 | 17.85 | 22.71 |
| 92 | sludge only | 35 | 0.88 | 20.31 | 28.81 |
| 91 | sludge only | 35 | 0.88 | 22.87 | 35.88 |
| 90 | sludge only | 35 | 0.88 | 25.98 | 45.40 |
| 87 | sludge only | 35 | 0.21 | 17.93 | 23.06 |
| 86 | sludge only | 35 | 0.21 | 11.90 | 11.15 |
| 85 | sludge only | 35 | 0.21 | 11.99 | 11.44 |
| 84 | sludge only | 35 | 0.21 | 12.03 | 11.62 |
| 83 | sludge only | 35 | 0.21 | 25.20 | 43.31 |
| 82 | sludge only | 35 | 0.21 | 11.90 | 11.42 |
| 81 | sludge only | 35 | 0.21 | 11.98 | 11.69 |
| 80 | sludge only | 35 | 0.21 | 20.30 | 29.66 |
| 79 | sludge only | 35 | 0.21 | 20.78 | 30.94 |
| 78 | sludge only | 35 | 0.21 | 14.77 | 16.90 |
| 77 | sludge only | 35 | 0.21 | 14.83 | 17.13 |
| 76 | sludge only | 35 | 0.21 | 12.04 | 12.08 |
| 75 | sludge only | 35 | 0.21 | 17.78 | 23.26 |
| 74 | sludge only | 35 | 0.21 | 11.99 | 11.77 |
| 73 | sludge only | 35 | 0.21 | 11.88 | 12.08 |
| 72 | sludge only | 35 | 0.21 | 11.97 | 13.06 |
| 71 | sludge only | 35 | 0.21 | 20.30 | 33.08 |
| 70 | sludge only | 35 | 0.21 | 17.93 | 26.52 |
| 69 | sludge only | 35 | 0.21 | 25.36 | 49.17 |
| 68 | sludge only | 35 | 0.21 | 22.90 | 40.17 |
| 67 | sludge only | 35 | 0.21 | 20.37 | 32.50 |
| 66 | sludge only | 35 | 0.21 | 17.81 | 25.39 |
| 65 | sludge only | 35 | 0.21 | 20.27 | 32.04 |
| 64 | sludge only | 35 | 0.21 | 22.96 | 40.07 |
| 63 | sludge only | 35 | 0.21 | 25.47 | 48.46 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 62 | sludge only | 35 | 0.21 | 25.47 | 48.38 |
| 61 | sludge only | 35 | 0.21 | 21.02 | 34.12 |
| 60 | sludge only | 35 | 0.21 | 16.04 | 20.84 |
| 59 | sludge only | 35 | 0.21 | 11.88 | 12.13 |
| 58 | sludge only | 35 | 0.21 | 16.02 | 21.04 |
| 57 | sludge only | 35 | 0.21 | 21.02 | 34.43 |
| 56 | sludge only | 35 | 0.21 | 25.41 | 48.78 |
| 55 | sludge only | 35 | 0.21 | 22.63 | 39.66 |
| 54 | sludge only | 35 | 0.21 | 20.19 | 32.33 |
| 53 | sludge only | 35 | 0.21 | 17.62 | 25.21 |
| 52 | sludge only | 35 | 0.21 | 20.16 | 32.10 |
| 51 | sludge only | 35 | 0.21 | 22.54 | 39.18 |
| 50 | sludge only | 35 | 0.21 | 25.40 | 48.60 |
| 42 | sludge only | 35 | 0.044 | 19.86 | 30.15 |
| 41 | sludge only | 35 | 0.044 | 19.87 | 30.63 |
| 40 | sludge only | 35 | 0.044 | 14.82 | 17.44 |
| 39 | sludge only | 35 | 0.044 | 17.97 | 24.85 |
| 38 | sludge only | 35 | 0.044 | 17.90 | 24.38 |
| 37 | sludge only | 35 | 0.044 | 20.86 | 31.93 |
| 36 | sludge only | 35 | 0.044 | 18.84 | 26.12 |
| 35 | sludge only | 35 | 0.044 | 18.84 | 26.08 |
| 34 | sludge only | 35 | 0.044 | 13.50 | 14.15 |
| 33 | sludge only | 35 | 0.044 | 12.04 | 11.81 |
| 32 | sludge only | 35 | 0.044 | 13.51 | 14.87 |
| 31 | sludge only | 35 | 0.044 | 12.05 | 12.76 |
| 30 | sludge only | 35 | 0.044 | 17.41 | 21.77 |
| 29 | sludge only | 35 | 0.044 | 25.84 | 44.25 |
| 28 | sludge only | 35 | 0.044 | 21.07 | 30.54 |
| 27 | sludge only | 35 | 0.044 | 12.03 | 11.31 |
| 26 | sludge only | 35 | 0.044 | 13.52 | 13.73 |
| 25 | sludge only | 35 | 0.044 | 17.39 | 21.31 |
| 24 | sludge only | 35 | 0.044 | 26.53 | 45.81 |
| 23 | sludge only | 35 | 0.044 | 21.37 | 30.04 |
| 22 | sludge only | 35 | 0.044 | 16.65 | 19.56 |
| 21 | sludge only | 35 | 0.044 | 11.90 | 11.52 |
| 20 | sludge only | 35 | 0.044 | 16.67 | 20.36 |
| 19 | sludge only | 35 | 0.044 | 21.40 | 31.50 |
| 18 | sludge only | 35 | 0.044 | 26.51 | 45.78 |
| 17 | sludge only | 35 | 0.044 | 22.30 | 32.96 |
| 16 | sludge only | 35 | 0.044 | 20.54 | 28.09 |
| 15 | sludge only | 35 | 0.044 | 17.91 | 21.71 |
| 14 | sludge only | 35 | 0.044 | 20.60 | 28.31 |
| 13 | sludge only | 35 | 0.044 | 22.32 | 32.76 |
| 12 | sludge only | 35 | 0.044 | 26.46 | 44.48 |
| 11 | sludge only | 35 | 0.044 | 26.42 | 45.87 |
| | | | | | |
| 30 | Sludge+MST | 35 | 0.033 | 26.10 | 44.53 |
| 31 | Sludge+MST | 35 | 0.033 | 22.85 | 34.97 |
| 32 | Sludge+MST | 35 | 0.033 | 20.59 | 28.91 |
| 33 | Sludge+MST | 35 | 0.033 | 17.96 | 22.28 |
| 34 | Sludge+MST | 35 | 0.033 | 20.69 | 28.99 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 35 | Sludge+MST | 35 | 0.033 | 23.34 | 36.40 |
| 36 | Sludge+MST | 35 | 0.033 | 26.16 | 44.84 |
| 37 | Sludge+MST | 35 | 0.033 | 21.74 | 31.92 |
| 38 | Sludge+MST | 35 | 0.033 | 16.83 | 19.90 |
| 39 | Sludge+MST | 35 | 0.033 | 11.93 | 10.54 |
| 40 | Sludge+MST | 35 | 0.033 | 16.82 | 19.95 |
| 41 | Sludge+MST | 35 | 0.033 | 21.73 | 31.82 |
| 42 | Sludge+MST | 35 | 0.033 | 26.15 | 44.67 |
| 43 | Sludge+MST | 35 | 0.033 | 16.67 | 19.24 |
| 44 | Sludge+MST | 35 | 0.033 | 13.58 | 13.22 |
| 45 | Sludge+MST | 35 | 0.033 | 14.89 | 15.64 |
| 46 | Sludge+MST | 35 | 0.033 | 12.09 | 10.75 |
| 47 | Sludge+MST | 35 | 0.033 | 13.55 | 13.29 |
| 48 | Sludge+MST | 35 | 0.033 | 17.48 | 21.32 |
| 49 | Sludge+MST | 35 | 0.033 | 18.89 | 24.49 |
| 50 | Sludge+MST | 35 | 0.033 | 17.47 | 21.31 |
| 51 | Sludge+MST | 35 | 0.033 | 18.89 | 24.52 |
| 52 | Sludge+MST | 35 | 0.033 | 12.05 | 10.70 |
| 53 | Sludge+MST | 35 | 0.033 | 13.55 | 13.24 |
| 54 | Sludge+MST | 35 | 0.033 | 18.02 | 22.52 |
| 55 | Sludge+MST | 35 | 0.033 | 17.97 | 22.43 |
| 56 | Sludge+MST | 35 | 0.033 | 20.97 | 29.57 |
| 57 | Sludge+MST | 35 | 0.033 | 26.00 | 43.97 |
| 58 | Sludge+MST | 35 | 0.033 | 12.10 | 10.58 |
| 59 | Sludge+MST | 35 | 0.033 | 21.16 | 30.07 |
| 60 | Sludge+MST | 35 | 0.25 | 18.00 | 22.48 |
| 61 | Sludge+MST | 35 | 0.25 | 26.27 | 45.02 |
| 62 | Sludge+MST | 35 | 0.25 | 23.48 | 36.66 |
| 63 | Sludge+MST | 35 | 0.25 | 20.63 | 29.01 |
| 64 | Sludge+MST | 35 | 0.25 | 17.83 | 22.22 |
| 65 | Sludge+MST | 35 | 0.25 | 20.67 | 29.08 |
| 66 | Sludge+MST | 35 | 0.25 | 23.58 | 36.91 |
| 67 | Sludge+MST | 35 | 0.25 | 26.25 | 44.93 |
| 68 | Sludge+MST | 35 | 0.25 | 21.42 | 30.78 |
| 69 | Sludge+MST | 35 | 0.25 | 16.68 | 19.36 |
| 70 | Sludge+MST | 35 | 0.25 | 11.93 | 10.38 |
| 71 | Sludge+MST | 35 | 0.25 | 12.09 | 10.62 |
| 72 | Sludge+MST | 35 | 0.25 | 21.43 | 30.78 |
| 73 | Sludge+MST | 35 | 0.25 | 26.27 | 44.79 |
| 74 | Sludge+MST | 35 | 0.25 | 21.41 | 30.80 |
| 75 | Sludge+MST | 35 | 0.25 | 20.40 | 28.10 |
| 76 | Sludge+MST | 35 | 0.25 | 12.04 | 10.54 |
| 77 | Sludge+MST | 35 | 0.25 | 11.97 | 10.24 |
| 78 | Sludge+MST | 35 | 0.25 | 12.05 | 10.54 |
| 79 | Sludge+MST | 35 | 0.25 | 17.80 | 21.87 |
| 80 | Sludge+MST | 35 | 0.25 | 12.08 | 10.62 |
| 81 | Sludge+MST | 35 | 0.25 | 14.90 | 15.77 |
| 82 | Sludge+MST | 35 | 0.25 | 14.84 | 15.72 |
| 83 | Sludge+MST | 35 | 0.25 | 20.96 | 29.74 |
| 84 | Sludge+MST | 35 | 0.25 | 20.37 | 28.14 |
| 85 | Sludge+MST | 35 | 0.25 | 12.03 | 10.62 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 86 | Sludge+MST | 35 | 0.25 | 11.98 | 10.48 |
| 87 | Sludge+MST | 35 | 0.25 | 26.13 | 44.59 |
| 88 | Sludge+MST | 35 | 0.25 | 12.07 | 10.71 |
| 89 | Sludge+MST | 35 | 0.25 | 12.04 | 10.56 |
| 90 | Sludge+MST | 35 | 0.25 | 11.97 | 10.34 |
| 91 | Sludge+MST | 35 | 0.25 | 17.81 | 21.85 |
| 92 | Sludge+MST | 35 | 0.25 | 14.89 | 15.74 |
| 93 | Sludge+MST | 35 | 0.25 | 20.38 | 27.98 |
| 94 | Sludge+MST | 35 | 1.1 | 26.30 | 44.64 |
| 95 | Sludge+MST | 35 | 1.1 | 23.49 | 36.34 |
| 96 | Sludge+MST | 35 | 1.1 | 20.56 | 28.49 |
| 97 | Sludge+MST | 35 | 1.1 | 17.89 | 22.01 |
| 98 | Sludge+MST | 35 | 1.1 | 20.56 | 28.58 |
| 99 | Sludge+MST | 35 | 1.1 | 23.49 | 36.48 |
| 100 | Sludge+MST | 35 | 1.1 | 26.37 | 45.09 |
| 101 | Sludge+MST | 35 | 1.1 | 21.38 | 30.60 |
| 102 | Sludge+MST | 35 | 1.1 | 16.64 | 19.28 |
| 103 | Sludge+MST | 35 | 1.1 | 11.90 | 10.40 |
| 104 | Sludge+MST | 35 | 1.1 | 16.23 | 19.27 |
| 105 | Sludge+MST | 35 | 1.1 | 21.36 | 30.64 |
| 106 | Sludge+MST | 35 | 1.1 | 26.38 | 45.03 |
| 107 | Sludge+MST | 35 | 1.1 | 22.85 | 34.45 |
| 108 | Sludge+MST | 35 | 1.1 | 12.61 | 11.54 |
| 109 | Sludge+MST | 35 | 1.1 | 26.21 | 44.59 |
| 110 | Sludge+MST | 35 | 1.1 | 11.85 | 10.10 |
| 111 | Sludge+MST | 35 | 1.1 | 17.43 | 20.57 |
| 112 | Sludge+MST | 35 | 1.1 | 14.84 | 15.32 |
| 113 | Sludge+MST | 35 | 1.1 | 11.89 | 10.16 |
| 114 | Sludge+MST | 35 | 1.1 | 17.39 | 20.80 |
| 115 | Sludge+MST | 35 | 1.1 | 26.23 | 44.64 |
| 116 | Sludge+MST | 35 | 1.1 | 11.85 | 10.22 |
| 117 | Sludge+MST | 35 | 1.1 | 17.53 | 21.23 |
| 118 | Sludge+MST | 35 | 1.1 | 11.85 | 10.28 |
| 119 | Sludge+MST | 35 | 1.1 | 11.88 | 10.37 |
| 120 | Sludge+MST | 35 | 1.1 | 17.79 | 21.86 |
| 121 | Sludge+MST | 35 | 1.1 | 21.79 | 31.85 |
| 122 | Sludge+MST | 35 | 1.1 | 11.85 | 10.29 |
| 123 | Sludge+MST | 35 | 1.1 | 11.89 | 10.39 |
| 124 | Sludge+MST | 35 | 1.1 | 17.73 | 21.69 |
| 125 | Sludge+MST | 35 | 1.1 | 21.79 | 31.11 |
| 126 | Sludge+MST | 35 | 4.2 | 26.37 | 43.99 |
| 127 | Sludge+MST | 35 | 4.2 | 23.47 | 35.32 |
| 128 | Sludge+MST | 35 | 4.2 | 20.48 | 27.27 |
| 129 | Sludge+MST | 35 | 4.2 | 17.53 | 20.36 |
| 130 | Sludge+MST | 35 | 4.2 | 20.59 | 27.53 |
| 131 | Sludge+MST | 35 | 4.2 | 23.58 | 35.53 |
| 132 | Sludge+MST | 35 | 4.2 | 26.44 | 44.25 |
| 133 | Sludge+MST | 35 | 4.2 | 21.64 | 30.58 |
| 134 | Sludge+MST | 35 | 4.2 | 16.76 | 19.13 |
| 135 | Sludge+MST | 35 | 4.2 | 11.87 | 10.06 |
| 136 | Sludge+MST | 35 | 4.2 | 16.75 | 19.16 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 137 | Sludge+MST | 35 | 4.2 | 21.58 | 30.56 |
| 138 | Sludge+MST | 35 | 4.2 | 26.44 | 44.19 |
| 139 | Sludge+MST | 35 | 4.2 | 20.79 | 28.32 |
| 140 | Sludge+MST | 35 | 4.2 | 17.88 | 21.34 |
| 141 | Sludge+MST | 35 | 4.2 | 11.84 | 9.72 |
| 142 | Sludge+MST | 35 | 4.2 | 13.94 | 13.40 |
| 143 | Sludge+MST | 35 | 4.2 | 16.80 | 18.89 |
| 144 | Sludge+MST | 35 | 4.2 | 11.87 | 10.05 |
| 145 | Sludge+MST | 35 | 4.2 | 11.87 | 10.08 |
| 146 | Sludge+MST | 35 | 4.2 | 11.83 | 9.95 |
| 147 | Sludge+MST | 35 | 4.2 | 11.83 | 9.99 |
| 148 | Sludge+MST | 35 | 4.2 | 11.87 | 10.14 |
| 149 | Sludge+MST | 35 | 4.2 | 16.85 | 19.22 |
| 150 | Sludge+MST | 35 | 4.2 | 25.93 | 42.94 |
| 151 | Sludge+MST | 35 | 4.2 | 16.85 | 19.25 |
| 152 | Sludge+MST | 35 | 4.2 | 15.78 | 17.11 |
| 153 | Sludge+MST | 35 | 4.2 | 15.84 | 17.24 |
| 154 | Sludge+MST | 35 | 4.2 | 11.84 | 9.82 |
| | | | | | |
| 37 | 6.4 M Sludge+MST | 35 | 0.05 | 8.97 | 6.69 |
| 38 | 6.4 M Sludge+MST | 35 | 0.05 | 11.94 | 11.33 |
| 39 | 6.4 M Sludge+MST | 35 | 0.05 | 4.04 | 1.54 |
| 40 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.59 |
| 41 | 6.4 M Sludge+MST | 35 | 0.05 | 11.90 | 11.15 |
| 42 | 6.4 M Sludge+MST | 35 | 0.05 | 8.96 | 6.61 |
| 43 | 6.4 M Sludge+MST | 35 | 0.05 | 5.98 | 3.16 |
| 44 | 6.4 M Sludge+MST | 35 | 0.05 | 8.98 | 6.64 |
| 45 | 6.4 M Sludge+MST | 35 | 0.05 | 14.01 | 14.92 |
| 46 | 6.4 M Sludge+MST | 35 | 0.05 | 5.96 | 2.97 |
| 47 | 6.4 M Sludge+MST | 35 | 0.05 | 8.95 | 6.49 |
| 52 | 6.4 M Sludge+MST | 35 | 0.05 | 8.94 | 6.58 |
| 53 | 6.4 M Sludge+MST | 35 | 0.05 | 11.92 | 11.16 |
| 54 | 6.4 M Sludge+MST | 35 | 0.05 | 4.02 | 1.47 |
| 55 | 6.4 M Sludge+MST | 35 | 0.05 | 8.91 | 6.51 |
| 56 | 6.4 M Sludge+MST | 35 | 0.05 | 11.89 | 11.02 |
| 57 | 6.4 M Sludge+MST | 35 | 0.05 | 8.94 | 6.50 |
| 58 | 6.4 M Sludge+MST | 35 | 0.05 | 5.97 | 3.06 |
| 59 | 6.4 M Sludge+MST | 35 | 0.05 | 8.95 | 6.54 |
| 60 | 6.4 M Sludge+MST | 35 | 0.05 | 14.00 | 14.78 |
| 61 | 6.4 M Sludge+MST | 35 | 0.05 | 5.93 | 2.92 |
| 62 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.44 |
| 66 | 6.4 M Sludge+MST | 35 | 0.74 | 8.93 | 6.71 |
| 67 | 6.4 M Sludge+MST | 35 | 0.74 | 11.90 | 11.22 |
| 68 | 6.4 M Sludge+MST | 35 | 0.74 | 3.99 | 1.61 |
| 69 | 6.4 M Sludge+MST | 35 | 0.74 | 8.86 | 6.42 |
| 70 | 6.4 M Sludge+MST | 35 | 0.74 | 11.88 | 11.03 |
| 71 | 6.4 M Sludge+MST | 35 | 0.74 | 8.93 | 5.58 |
| 72 | 6.4 M Sludge+MST | 35 | 0.74 | 5.93 | 3.31 |
| 73 | 6.4 M Sludge+MST | 35 | 0.74 | 8.92 | 6.89 |
| 74 | 6.4 M Sludge+MST | 35 | 0.74 | 13.98 | 14.90 |
| 75 | 6.4 M Sludge+MST | 35 | 0.74 | 5.92 | 3.06 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 76 | 6.4 M Sludge+MST | 35 | 0.74 | 8.92 | 6.66 |
| 81 | 6.4 M Sludge+MST | 35 | 0.74 | 8.92 | 6.70 |
| 82 | 6.4 M Sludge+MST | 35 | 0.74 | 11.90 | 11.29 |
| 83 | 6.4 M Sludge+MST | 35 | 0.74 | 3.98 | 1.66 |
| 84 | 6.4 M Sludge+MST | 35 | 0.74 | 8.90 | 6.59 |
| 85 | 6.4 M Sludge+MST | 35 | 0.74 | 11.88 | 11.07 |
| 86 | 6.4 M Sludge+MST | 35 | 0.74 | 8.92 | 6.63 |
| 87 | 6.4 M Sludge+MST | 35 | 0.74 | 5.93 | 3.32 |
| 88 | 6.4 M Sludge+MST | 35 | 0.74 | 8.92 | 6.76 |
| 89 | 6.4 M Sludge+MST | 35 | 0.74 | 13.97 | 14.83 |
| 90 | 6.4 M Sludge+MST | 35 | 0.74 | 5.91 | 2.97 |
| 91 | 6.4 M Sludge+MST | 35 | 0.74 | 8.91 | 6.53 |
| 95 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.13 |
| 96 | 6.4 M Sludge+MST | 35 | 0.05 | 11.94 | 10.79 |
| 97 | 6.4 M Sludge+MST | 35 | 0.05 | 4.01 | 1.25 |
| 98 | 6.4 M Sludge+MST | 35 | 0.05 | 8.90 | 6.00 |
| 99 | 6.4 M Sludge+MST | 35 | 0.05 | 11.87 | 10.44 |
| 100 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.21 |
| 101 | 6.4 M Sludge+MST | 35 | 0.05 | 5.96 | 2.87 |
| 102 | 6.4 M Sludge+MST | 35 | 0.05 | 8.94 | 6.27 |
| 103 | 6.4 M Sludge+MST | 35 | 0.05 | 13.97 | 14.24 |
| 104 | 6.4 M Sludge+MST | 35 | 0.05 | 5.93 | 2.69 |
| 105 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.22 |
| 110 | 6.4 M Sludge+MST | 35 | 0.05 | 8.93 | 6.34 |
| 111 | 6.4 M Sludge+MST | 35 | 0.05 | 11.89 | 10.90 |
| 112 | 6.4 M Sludge+MST | 35 | 0.05 | 4.02 | 1.26 |
| 113 | 6.4 M Sludge+MST | 35 | 0.05 | 8.90 | 6.25 |
| 114 | 6.4 M Sludge+MST | 35 | 0.05 | 11.87 | 10.74 |
| 115 | 6.4 M Sludge+MST | 35 | 0.05 | 8.92 | 6.28 |
| 116 | 6.4 M Sludge+MST | 35 | 0.05 | 5.95 | 2.88 |
| 117 | 6.4 M Sludge+MST | 35 | 0.05 | 8.94 | 6.31 |
| 118 | 6.4 M Sludge+MST | 35 | 0.05 | 13.97 | 14.52 |
| 119 | 6.4 M Sludge+MST | 35 | 0.05 | 5.92 | 2.78 |
| 120 | 6.4 M Sludge+MST | 35 | 0.05 | 8.92 | 6.27 |
| 124 | 6.4 M Sludge+MST | 35 | 0.1 | 8.92 | 6.40 |
| 125 | 6.4 M Sludge+MST | 35 | 0.1 | 11.90 | 10.93 |
| 126 | 6.4 M Sludge+MST | 35 | 0.1 | 4.01 | 1.32 |
| 127 | 6.4 M Sludge+MST | 35 | 0.1 | 8.90 | 6.32 |
| 128 | 6.4 M Sludge+MST | 35 | 0.1 | 11.87 | 10.85 |
| 129 | 6.4 M Sludge+MST | 35 | 0.1 | 8.92 | 6.36 |
| 130 | 6.4 M Sludge+MST | 35 | 0.1 | 5.95 | 2.97 |
| 131 | 6.4 M Sludge+MST | 35 | 0.1 | 8.94 | 6.40 |
| 132 | 6.4 M Sludge+MST | 35 | 0.1 | 13.97 | 14.60 |
| 133 | 6.4 M Sludge+MST | 35 | 0.1 | 5.92 | 2.86 |
| 134 | 6.4 M Sludge+MST | 35 | 0.1 | 8.92 | 6.34 |
| 139 | 6.4 M Sludge+MST | 35 | 0.1 | 8.93 | 6.46 |
| 140 | 6.4 M Sludge+MST | 35 | 0.1 | 11.89 | 11.00 |
| 141 | 6.4 M Sludge+MST | 35 | 0.1 | 4.00 | 1.38 |
| 142 | 6.4 M Sludge+MST | 35 | 0.1 | 8.90 | 6.27 |
| 143 | 6.4 M Sludge+MST | 35 | 0.1 | 11.86 | 10.78 |
| 144 | 6.4 M Sludge+MST | 35 | 0.1 | 8.92 | 6.33 |

| Test | Feed | Temp | Conc (wt %) | Vel (ft/s) | DP (psi) |
|---|---|---|---|---|---|
| 145 | 6.4 M Sludge+MST | 35 | 0.1 | 5.94 | 2.95 |
| 146 | 6.4 M Sludge+MST | 35 | 0.1 | 8.94 | 6.37 |
| 147 | 6.4 M Sludge+MST | 35 | 0.1 | 13.96 | 14.55 |
| 148 | 6.4 M Sludge+MST | 35 | 0.1 | 5.92 | 2.82 |
| 149 | 6.4 M Sludge+MST | 35 | 0.1 | 8.92 | 6.31 |
| 153 | 6.4 M Sludge+MST | 35 | 0.2 | 8.92 | 6.50 |
| 154 | 6.4 M Sludge+MST | 35 | 0.2 | 11.89 | 11.07 |
| 155 | 6.4 M Sludge+MST | 35 | 0.2 | 4.00 | 1.45 |
| 156 | 6.4 M Sludge+MST | 35 | 0.2 | 8.90 | 6.31 |
| 157 | 6.4 M Sludge+MST | 35 | 0.2 | 11.86 | 10.84 |
| 158 | 6.4 M Sludge+MST | 35 | 0.2 | 8.91 | 6.38 |
| 159 | 6.4 M Sludge+MST | 35 | 0.2 | 5.94 | 2.98 |
| 160 | 6.4 M Sludge+MST | 35 | 0.2 | 8.93 | 6.41 |
| 161 | 6.4 M Sludge+MST | 35 | 0.2 | 13.95 | 14.67 |
| 162 | 6.4 M Sludge+MST | 35 | 0.2 | 5.92 | 2.89 |
| 163 | 6.4 M Sludge+MST | 35 | 0.2 | 8.92 | 6.35 |
| 168 | 6.4 M Sludge+MST | 35 | 0.2 | 8.91 | 6.48 |
| 169 | 6.4 M Sludge+MST | 35 | 0.2 | 11.85 | 10.99 |
| 170 | 6.4 M Sludge+MST | 35 | 0.2 | 3.99 | 1.38 |
| 171 | 6.4 M Sludge+MST | 35 | 0.2 | 8.88 | 6.34 |
| 172 | 6.4 M Sludge+MST | 35 | 0.2 | 11.87 | 10.89 |
| 173 | 6.4 M Sludge+MST | 35 | 0.2 | 8.91 | 6.38 |
| 174 | 6.4 M Sludge+MST | 35 | 0.2 | 5.95 | 3.00 |
| 175 | 6.4 M Sludge+MST | 35 | 0.2 | 8.93 | 6.42 |
| 176 | 6.4 M Sludge+MST | 35 | 0.2 | 13.97 | 14.69 |
| 177 | 6.4 M Sludge+MST | 35 | 0.2 | 5.91 | 2.87 |
| 178 | 6.4 M Sludge+MST | 35 | 0.2 | 8.91 | 6.36 |
| 182 | 6.4 M Sludge+MST | 35 | 0.39 | 8.90 | 6.62 |
| 183 | 6.4 M Sludge+MST | 35 | 0.39 | 11.88 | 11.21 |
| 184 | 6.4 M Sludge+MST | 35 | 0.39 | 3.99 | 1.58 |
| 185 | 6.4 M Sludge+MST | 35 | 0.39 | 8.89 | 6.48 |
| 186 | 6.4 M Sludge+MST | 35 | 0.39 | 11.86 | 11.05 |
| 187 | 6.4 M Sludge+MST | 35 | 0.39 | 8.90 | 6.54 |
| 188 | 6.4 M Sludge+MST | 35 | 0.39 | 5.92 | 3.18 |
| 189 | 6.4 M Sludge+MST | 35 | 0.39 | 8.92 | 6.62 |
| 190 | 6.4 M Sludge+MST | 35 | 0.39 | 13.97 | 14.94 |
| 191 | 6.4 M Sludge+MST | 35 | 0.39 | 5.93 | 3.07 |
| 192 | 6.4 M Sludge+MST | 35 | 0.39 | 8.88 | 6.51 |
| 197 | 6.4 M Sludge+MST | 35 | 0.39 | 8.90 | 6.75 |
| 198 | 6.4 M Sludge+MST | 35 | 0.39 | 11.87 | 11.33 |
| 199 | 6.4 M Sludge+MST | 35 | 0.39 | 3.98 | 1.61 |
| 200 | 6.4 M Sludge+MST | 35 | 0.39 | 8.92 | 6.55 |
| 201 | 6.4 M Sludge+MST | 35 | 0.39 | 11.85 | 11.07 |
| 202 | 6.4 M Sludge+MST | 35 | 0.39 | 8.90 | 6.53 |
| 203 | 6.4 M Sludge+MST | 35 | 0.39 | 5.92 | 3.14 |
| 204 | 6.4 M Sludge+MST | 35 | 0.39 | 8.91 | 6.55 |
| 205 | 6.4 M Sludge+MST | 35 | 0.39 | 13.95 | 14.81 |
| 206 | 6.4 M Sludge+MST | 35 | 0.39 | 5.91 | 2.99 |
| 207 | 6.4 M Sludge+MST | 35 | 0.39 | 8.90 | 6.49 |